Spectrum Properties of Partially Coherent Modified Bessel-Gauss Beams by a Lens with Aperture

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Starting from the propagation equation of partially coherent light, the spectral shift and spectral switch of partially coherent modified Bessel-Gauss beams passing through a lens with aperture are studied. Numerical results show that the on-axis spectrum in the near zone is different from the spectrum of the source, and the on-axis spectrum in the near zone is split into multi-peaks. It is also found that the spectral shift shows a gradual change. However, when z_f approaches a critical value, a rapid spectral transition occurs. The effect is called spectral switch. For example, when the parameters for calculation are the central frequency of the spectrum $\omega_0 = 3.2 * 10^{15} s^{-1}$, effective coherence length on the source plane $\sigma_0 = 0.6 * 10^{15} s^{-1}$, Fresnel number of beam $N_w = 1$, the spectral degree of coherence $\xi = 0.5$, and truncation parameter $\delta = 0.3$. For the axial spectrum at $z_f = 0.0105$, the relative spectral shift is bigger than zero, and the blue shift occurs. The two major peaks reach the same height at the critical point $z_f = 0.0111$, and the subordinate peaks separately at the both sides of major peaks also reach the same height. This means that the spectral shift is transformed from the blue shift to the red shift, and the spectral switch occurs at this point. With the increase of z_f, the red shift decreases. When z_f equals 0.0127, the spectral shift equals 0. When z_f equals 0.0148, the spectral switch occurs again. The distance between the major peaks when z_f equals 0.0127 is larger than that when z_f equals 0.0111. Numerical results also show that the spectral switch positions and the spectral switch performance of partially coherent modified Bessel-Gauss beams depend on the spectral degree of coherence, Fresnel number of beam and truncation parameter. The number of spectral switch increases with the increase of the Fresnel number of beam, and decreases with the increase of the spectral degree of coherence.